

## CLAIMS

- [C001]1. A seal assembly comprising:
- an annular hanger including a supporting ledge;
  - an arcuate seal segment including a radially outer rail mounted on said ledge and supporting a radially inner seal;
  - an arcuate carrier mounted between said hanger and said rail, and including a piston mounted in a bore, a tubular bellows having an inner end joined to said piston, and an outer end joined to said carrier around said bore; and
  - an actuator for pressurizing said bore to deploy said piston between said hanger and said rail and retract said seal segment.
- [C002]2. A seal assembly according to claim 1 further comprising:
- a plurality of said seal segments mounted on said ledge; and
  - each of said segments includes a corresponding carrier having a piston mounted in a bore and collectively joined to said actuator for simultaneously retracting said seal segments.
- [C003]3. A seal assembly according to claim 2 wherein:
- each of said carriers includes a convex outer surface;
  - said bores are disposed through said convex outer surfaces; and
  - said pistons extend radially outwardly in said bores.
- [C004]4. A seal assembly according to claim 3 wherein:
- said hanger further includes forward and aft ledges spaced axially apart to define a supporting groove;
  - each of said seal segments further includes a shank extending inwardly from said rail for supporting said inner seal, and said rail bridges said forward and aft ledges in said groove for mounting said seal segments thereon; and
  - said carriers are mounted between said rail and at least one of said ledges.
- [C005]5. A seal assembly according to claim 4 further comprising:
- a plurality of forward carriers disposed between said forward ledge and said rail,

and including a piston sealingly mounted in a bore by a surrounding bellows;  
a plurality of aft carriers disposed between said aft ledge and said rail, and  
each including a piston sealingly mounted in a bore by a surrounding bellows; and  
said actuator are joined to both carriers for deploying said pistons therein  
and simultaneously retracting said seal segments on both ledges.

[C006] 6. A seal assembly according to claim 5 wherein:  
each of said forward carriers includes a plurality of said pistons sealingly  
mounted in respective bores by respective bellows; and  
each of said aft carriers includes a plurality of said pistons sealingly  
mounted in respective bores by respective bellows.

[C007] 7. A seal assembly according to claim 4 wherein:  
each seal segment further includes a shank extending radially inwardly  
from said rail;  
said shank includes an arcuate slot extending axially therethrough below  
said rail; and  
said carriers are mounted in said slots between said rail and both said  
ledges.

[C008] 8. A seal assembly according to claim 7 wherein:  
said carriers bridge said forward and aft ledges to radially support said rail  
thereatop; and  
said slots are radially larger than said carriers to provide corresponding  
retraction clearances in said shanks below said carriers.

[C009] 9. A seal assembly according to claim 3 wherein:  
said hanger includes a single forward ledge defining a supporting groove;  
said rail includes a forward portion mounted on said ledge, and an aft  
portion suspended therefrom;  
said carriers are suspended below said rail aft portion by a plurality of  
bolts extending through clearance holes in said rail and fixedly joined to said hanger;  
said carriers include convex outer surfaces;

said bores are disposed through said convex outer surfaces; and  
said pistons extend radially outwardly in said bores.

**[C010]** 10. A seal assembly according to claim 3 wherein said inner seal comprises a plurality of spaced apart labyrinth seal teeth or a brush seal.

**[C011]** 11. A seal assembly comprising:  
an annular hanger including a supporting ledge;  
an arcuate seal segment including a radially outer rail mounted on said ledge and supporting a radially inner seal;  
an arcuate carrier mounted between said hanger and said rail, and including a piston mounted in a bore; and  
an actuator for pressurizing said bore to deploy said piston between said hanger and said rail and retract said seal segment.

**[C012]** 12. A seal assembly according to claim 11 further comprising a tubular bellows sealingly joining said piston to said carrier around said bore.

**[C013]** 13. A seal assembly according to claim 12 wherein said bellows includes an inner end joined to said piston, and an outer end joined to said carrier around said bore.

**[C014]** 14. A seal assembly according to claim 13 wherein said bellows inner end is joined to an inner end of said piston, and said bellows outer end is joined to said carrier at an outer end of said bore.

**[C015]** 15. A seal assembly according to claim 13 wherein:  
said carrier includes a convex outer surface;  
said bore is disposed through said convex outer surface; and  
said piston extends radially outwardly in said bore.

**[C016]** 16. A seal assembly according to claim 13 wherein said carrier includes a plurality of said bores spaced circumferentially apart, and each includes a piston sealed therein by a surrounding bellows.

[C017] 17. A seal assembly according to claim 16 wherein:  
said carrier further includes a manifold joining together said bores; and  
said actuator is joined in flow communication with said manifold for  
simultaneously pressurizing said bores to simultaneously deploy said pistons.

[C018] 18. A seal assembly according to claim 13 further comprising:  
a plurality of said seal segments mounted on said ledge; and  
each of said segments includes a corresponding carrier having a piston  
mounted in a bore and collectively joined to said actuator for simultaneously retracting  
said seal segments.

[C019] 19. A seal assembly according to claim 13 wherein:  
said hanger further includes forward and aft ledges spaced axially apart to  
define a supporting groove;  
said seal segment further includes a shank extending inwardly from said  
rail for supporting said inner seal, and said rail bridges said forward and aft ledges in said  
groove for mounting said seal segment thereon; and  
said carrier is mounted between said rail and at least one of said ledges.

[C020] 20. A seal assembly according to claim 19 further comprising:  
a forward carrier disposed between said forward ledge and said rail, and  
including a piston sealingly mounted in a bore by a surrounding bellows;  
an aft carrier disposed between said aft ledge and said rail, and including a  
piston sealingly mounted in a bore by a surrounding bellows; and  
said actuator is joined to both carriers for deploying said pistons therein  
and simultaneously retracting said seal segment on both ledges.

[C021] 21. A seal assembly according to claim 20 further comprising:  
a plurality of said seal segments adjoining circumferentially;  
a plurality of said forward and aft carriers corresponding with said seal  
segments; and  
said forward carriers circumferentially adjoin each other in flow

communication, and said aft carriers circumferentially adjoin each other in flow communication.

[C022] 22. A seal assembly according to claim 21 wherein:  
each of said forward carriers includes a plurality of said pistons sealingly mounted in respective bores by respective bellows; and  
each of said aft carriers includes a plurality of said pistons sealingly mounted in respective bores by respective bellows.

[C023] 23. A seal assembly according to claim 22 wherein:  
said forward and aft carriers each include a convex outer surface;  
said bores are disposed through said convex outer surfaces; and  
said pistons extend radially outwardly in said bores.

[C024] 24. A seal assembly according to claim 23 wherein said inner seal comprises a plurality of spaced apart labyrinth seal teeth.

[C025] 25. A seal assembly according to claim 19 wherein:  
said seal segment further includes a shank extending radially inwardly from said rail;  
said shank includes an arcuate slot extending axially therethrough below said rail; and  
said carrier is mounted in said slot between said rail and both said ledges.

[C026] 26. A seal assembly according to claim 25 wherein:  
said carrier bridges said forward and aft ledges to radially support said rail thereatop; and  
said slot is radially larger than said carrier to provide a retraction clearance in said shank below said carrier.

[C027] 27. A seal assembly according to claim 26 wherein said carrier further includes a plurality of said pistons sealingly mounted in respective bores by respective bellows.

- [C028] 28. A seal assembly according to claim 27 wherein:  
said carrier includes a convex outer surface;  
said bores are disposed through said convex outer surface; and  
said pistons extend radially outwardly in said bores.
- [C029] 29. A seal assembly according to claim 28 wherein said inner seal comprises a plurality of spaced apart labyrinth seal teeth.
- [C030] 30. A seal assembly according to claim 13 wherein:  
said hanger includes a single forward ledge defining a supporting groove;  
said rail includes a forward portion mounted on said ledge, and an aft portion suspended therefrom; and  
said carrier is suspended under said rail aft portion by bolts extending through said rail and fixedly joined to said hanger.
- [C031] 31. A seal assembly according to claim 30 wherein:  
said bolts are circumferentially spaced apart, and extend radially through clearance holes in said rail;  
said carrier includes a convex outer surface;  
said bore is disposed through said convex outer surface; and  
said piston extends radially outwardly in said bore to abut a radially inner surface of said rail.
- [C032] 32. A method of using said seal assembly according to claim 13 comprising:  
mounting said seal segment around a rotor; and  
pressurizing said bore as said rotor rotates to deploy said piston and retract said seal segment radially outwardly from said rotor.
- [C033] 33. A method according to claim 32 further comprising pressurizing said bore during transient rotation of said rotor.
- [C034] 34. A method according to claim 33 wherein said bore is pressurized during

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startup of said rotor.

**[C035]** 35. A method according to claim 33 where said bore is pressurized during shutdown of said rotor.